

REMARKS

This is in response to the Office action mailed July 7, 2003, and follows the interview of December 2, 2003. Reconsideration and reexamination are respectfully requested.

Amendment to the Specification

The Examiner has objected to the disclosure on the basis of an apparent clerical error at page 40. Applicant has amended the specification to correct the error. It is respectfully requested that this objection be withdrawn upon reconsideration.

Claim Amendments

Claim 1 has been amended to specifically require that the surfactant used in the initial hydrophobization step have an "HLB number greater than or equal to 15." Support for use of high HLB surfactants in the initial hydrophobizing step may be found, for example, at page 17, line 21 to page 18, line 10 of the specification, which states:

For hydrophilic particles such as untreated silica and clay, they are hydrophobized by adsorbing appropriate surfactants on the surface. After the initial hydrophobization step, a low HLB surfactant can be added to further enhance the hydrophobicity for improved dewatering. The surfactants that can be used for the initial hydrophobization step are usually high HLB surfactants whose polar head groups can interact with the surface via coulombic attraction, chemical bonding, electron-transfer, or acid-base interactions, while their non-polar tails are directed toward the aqueous phase. If a mineral concentrate is aged or oxidized during storage and transportation, however, it is necessary that the surface is re-hydrophobized using appropriate amount of collectors (or other high HLB surfactants) before adding the low HLB surfactants. (emphasis added).

The high HLB surfactants are discussed in the specification relative to the "low" HLB surfactants. The specification clearly identifies "low" HLB surfactants as those having an HLB

number less than 15, e.g. page 11, lines 3-6, page 16, lines 1-7, and in the Abstract. One skilled in the art would readily recognize that if low HLB surfactants are defined in the specification as having HLB number less than 15 then "high" HLB surfactants would have an HLB number greater or equal to 15. It is believed therefore that the amendment is well-supported by the specification. Dependent claim 74 has cancelled.

Independent claim 67 has been amended to clarify that the hydrocarbon oil is added to "initially" increase the hydrophobicity of the hydrophobic material. The nonionic low HLB surfactant is added in a second hydrophobization step. Support for this amendment may be found throughout the specification, e.g. at page 15, lines 12-17. Claim 75 has been rewritten in independent form.

35 U.S.C. §112, First Paragraph Rejections

Claim 74 has been rejected under 35 U.S.C. §112, first paragraph, as containing subject matter not described in the specification. Claim 74 has been cancelled, thereby rendering the rejection moot. Applicant respectfully requests, therefore, that the rejection be withdrawn upon reconsideration.

35 U.S.C. §103 Rejections

Claims 1, 2, 10, 11, 13, 67-69, 71-74, 77 and 78 have been rejected under 35 U.S.C. § 103, as being unpatentable over Yoon et. al. (U.S. Patent No. 5,670,056) in view of Yoon et al. (U.S. Patent No. 5,161,694). Applicant respectfully traverses this rejection.

Independent claims 1 and 67 both require use of a surfactant for initial hydrophobization, followed by a secondary hydrophobization using a different surfactant. In claim 1, the surfactant used in the initial hydrophobization has an “HLB number greater than or equal to 15” and the “nonionic” surfactant used in the second step has an “HLB number less than 15.” In claim 67, a “hydrocarbon oil” is used in the initial step and a “nonionic” surfactant of “HLB number less than 15” is used in the second step. There is nothing in Yoon et al. (056) or Yoon et al. (694), or their combination, that teaches or suggest the use of these two different surfactants in the claimed order.

As discussed during the interview of December 2, 2003, and as set forth in ¶¶21-24 of the Applicants “DECLARATION UNDER 37 C.F.R. §1.132” (hereinafter the “132 declaration”), the language at column 5, lines 37-39 in Yoon et al. (056) referring to “a combination of nonionic surfactant and hydrophobic polymers” has no connotation of sequencing. Moreover, the American Heritage Dictionary, College Edition, states that in the field of chemistry, the word “combine” means “to form a chemical compound”, and has no connotation for sequencing.

Also, the two-step hydrophobization process taught by Yoon et al. (694) involves surfactant followed by a hydrocarbon oil. The claimed invention, however, requires use of a hydrocarbon oil in an initial step and a non-ionic surfactant having an HLB number less than 15 in a second step. In the scientific community, hydrocarbon oils are not regarded as nonionic surfactants. Also, they are not part of the low HLB surfactants of the claimed invention, as listed in the specification, p. 16, second paragraph.

The Examiner has argued that use of non-ionic surfactants in the second hydrophobization step is an obvious extension of the method of using hydrocarbon oil as

described in Yoon et al. (694). First, there is nothing in any of the cited references that teaches or suggest using a hydrocarbon oil in an initial step and then a nonionic surfactant of HLB number less than 15 in a second step, as required by claim 67. Also, as set forth in ¶¶15-20 and Exhibits B and C of the 132 declaration, use of a low HLB surfactant in the second hydrophobization step, as claimed, results in a significant improvement in dewatering, especially for oxidized-coal.

Thus, neither Yoon (056) nor Yoon (694) teaches or suggests, either implicitly or explicitly, essential limitations of claims 1 or 67 requiring first and second hydrophobization steps and a nonionic low HLB surfactant in the second step. Moreover, ¶¶15-20 and Exhibits B and C of the 132 declaration, demonstrate that the claimed process has significant advantages over using a hydrocarbon oil.

Claims 2, 10-11, and 13, depend from independent claim 1 and are patentable over the cited references for the reasons discussed above by virtue of their dependency, as well as for other reasons. Claims 68-69, and 71-73, depend from independent claim 67 and are patentable over the cited references for the reasons discussed above by virtue of their dependency, as well as for other reasons. Claim 74 has been cancelled. As such, Applicant respectfully submits that the Examiner's rejection of claims 1, 2, 10, 11, 13, 67-69, 71-74, 77 and 78 under 35 U.S.C. § 103 as being unpatentable over Yoon et. al. ('056) in view of Yoon et al ('694) should be withdrawn upon reconsideration.

35 U.S.C. §103 Rejections

Claims 12 and 70 have been rejected under 35 U.S.C. § 103, as being unpatentable over Yoon et. al. (056) in view of Yoon et al. (694), and Wang et al. (531). Claim 12 depends

ultimately from claim 1 and claim 70 depends ultimately from claim 67. As such, these claims are allowable over the cited references for the reasons discussed above.

Also, as discussed in Applicants Amendment C dated May 19, 2003, Wang et al. teaches a method of using hydrophilic flocculant, followed by a combination of anionic surfactant and a water-insoluble organic liquid. Although the organic liquids identified by Wang et al. include the specific oils identified in claims 12 and 70, Applicant respectfully submits that it would not have been obvious to one skilled in the art to modify the process of Yoon et al. based on Wang et al.

First, Wang et al. blended anionic (high HLB) surfactants with the recited oils, while the claimed invention requires low HLB surfactants with the recited oils. The former makes the treated material more hydrophilic, while the latter makes it more hydrophobic. The effects of using high and low HLB surfactants are opposite. *Second*, Wang et al. teaches a method of using a mixture of anionic surfactant and oil after treating a mineral slurry with a flocculant. All of the flocculants identified by Wang et al. render the treated material hydrophilic. In the claimed invention, a material is hydrophobized first using appropriate surfactants, i.e., high HLB surfactants for oxides and thiols for sulfides. Applicant respectfully submits, therefore, that the Examiner's rejection of claims 12 and 70 under 35 U.S.C. 103(a) should be withdrawn upon reconsideration.

35 U.S.C. §103 Rejections

Claims 75 and 76 have been rejected under 35 U.S.C. § 103, as being unpatentable over Yoon et. al. (056) in view of Yoon et al. (694), and in view of Yoon et al. 5,814,210. Applicant respectfully traverses this rejection.

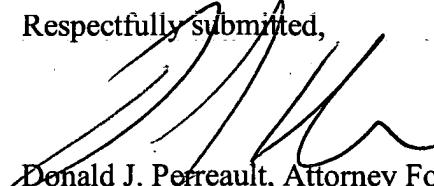
In claim 75, a "thiol-type" surfactant is used in the initial step and "nonionic" surfactant of "HLB number less than 15" is used in the second step. There is nothing in the cited references that teaches or suggest use of these surfactants in the claimed order. Moreover, as set forth in ¶¶ 6-14 and Exhibit A of the 132 declaration, use of a thiol-type surfactant in an initial hydrophobizing step followed by a nonionic surfactant of HLB number less than 15, as claimed, has important commercial advantages.

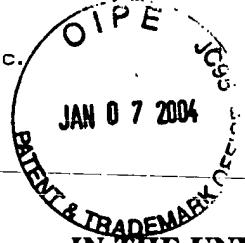
In view of the fact that the cited references fail to teach or suggest use of the claimed surfactants in the claimed manner, and the commercial importance of the claimed invention, Applicant submits that claim the process of claim 75 could not have been obvious to one skilled in the art at the time it was made. Claim 76 depends from claim 75. As such, applicant respectfully submits that the rejection of claims 75 and 76 under 35 U.S.C. § 103, as being unpatentable over Yoon et. al. (056) in view of Yoon et al. (694), and in view of Yoon et al. 5,814,210, should be withdrawn upon reconsideration.

Applicant respectfully submits that in light of the foregoing remarks, all of the presently pending claims are now in a condition for allowance. Reexamination and reconsideration are, therefore, respectfully requested.

In the event the Examiner deems personal contact desirable in disposition of this case, the Examiner is respectfully requested to call the undersigned attorney at (603) 668-6560. In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account No. 50-2121.

Respectfully submitted,


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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Appln of: YOON, Roe-Hoan Atty. Docket No.: MCT-004
Title: METHOD OF ENHANCING FINE PARTICLE DEWATERING
Serial No.: 09/327,266 Art Unit: 1724
Filed: June 7, 1999 Examiner: Hruskoci, Peter A

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

DECLARATION UNDER 37 C.F.R. §1.132

I, Dr. Roc-Hoan Yoon, declare and say:

BACKGROUND

1. I am the sole inventor of the subject matter disclosed and claimed in the above-identified patent application, and am familiar with the content of the application and the currently pending claims.
2. I graduated in 1967 with a Bachelor of Science degree from Seoul National University of Seoul, Korea, and in 1971 with a Master of Science degree from McGill University, Montreal, Canada. I also graduated in 1977 with a Doctor's degree from McGill University.
3. I am an endowed professor in the Department of Mining & Minerals Engineering at Virginia Polytechnic Institute and State University (Virginia Tech), of Blacksburg, Virginia.
4. I have been working in the field of mining and minerals engineering since about 1967.
5. I am familiar with U.S. Patent No. 5,670,056 (the '056 patent) cited by the Examiner. In fact, I am the primary inventor on the '056 patent.

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COMMERCIAL SUCCESS

6. The method claimed in the above-referenced application has been used commercially at Garpeburg zinc concentrator, which is owned and operated by New Boliden, formerly Boliden Minerals AB, in Sweden.
7. The results of an in-plant trial conducted on a full-scale rotary drum filter are shown in Exhibit A attached hereto.
8. As shown in Exhibit A, the moisture in cake was 12.3% when no dewatering aid was used, as indicated by the points at 0 kg/lb of dosage rate. The thickness of the filtration cake was only 0.55 cm representing a slow filtration rate and, hence, a low throughput.
9. The plot entitled "01DW110" in Exhibit A shows the results when a dewatering aid (01DW110) including a mixture of fatty esters was used. As shown, use of 01DW110 reduced the cake moisture to below 8%.
10. The plot entitled "Blend" in Exhibit A shows the results of another set of full-scale trial test conducted at Boliden using a process consistent with the claimed invention. In the test, a thiol-type surfactant, xanthate (high HLB surfactant), was added to initially hydrophobize the material. A reagent including a mixture of Span 80 (sorbitanmonooleate) and an oil of vegetable origin as solvent was then added.
11. The HLB number for the non-ionic low-HLB surfactant, Span 80, used in the test at Boliden, is 4.3.
12. As shown in Exhibit A, when the reagent blend which consisted of a low HLB surfactant (Span 80) and an oil of vegetable origin as solvent was used, the cake moisture was reduced considerably below those achieved with 01DW110. At 0.36 kg/ton of the reagent blend, the cake moisture was reduced to 7.77%, and the cake thickness was increased to 2.0 cm, representing a much higher filtration rate and a throughput than the case of using no dewatering aid, as represented by the points given 0 kg/ton dosage rate, and using 01DW110. The moisture was reduced further at a higher dosage, as shown.

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13. The test results demonstrated that the use of a process consistent with the invention results in reduced moisture at lower dosages as compared to the case of either not using any dewatering aid or the case using 01DW110 as dewatering aid.

14. As a result of the successful test results, Boliden has been using a process consistent with the claimed invention for the past two years particularly when dewatering becomes more difficult.

UNEXPECTED RESULTS IN USE OF NON-IONIC, LOW HLB SURFACTANT IN THE SECOND HYDROPHOBIZATION STEP

15. Exhibits B and C attached hereto illustrate laboratory Buchner funnel filtration test results comparing use of diesel in the claimed second hydrophobization step with use of sorbitan monooleate (a low HLB nonionic surfactant) in the second hydrophobization step.

16. For each test, hydrocarbon oil was used for the initial hydrophobization step. This reagent was added as collector during the flotation process.

17. In each test, the coal sample was a Pittsburgh coal sample taken from the Bailey coal preparation plant, CONSOL Energy. The particle size in each coal sample was finer than -0.6 mm. The tests were conducted at 0.6-inch cake thickness, 25-inch Hg vacuum pressure, and 16.4% solids.

18. Exhibit B shows results conducted on a fresh coal sample. As shown in Exhibit B, both the diesel and the nonionic surfactant reduced moisture when used in the second hydrophobization step. However, the nonionic surfactant gave much better results than diesel.

19. Exhibit C shows results obtained by oxidizing a fresh coal sample by allowing it to age for more than two weeks. As shown in Exhibit C, with the oxidized coal, diesel actually increased moisture, while the nonionic surfactant was still able to reduce the moisture substantially.

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20. These test results demonstrate that use of a non-ionic low HLB surfactant in the claimed second hydrophobization step provides improved results over use of diesel in the second hydrophobization step.

U.S. PATENT NO. 5,670,056

21. U.S. patent No. 5,670,056, column 5, lines 37-39 states:

"In addition, combinations of surfactants and hydrophobic polymers described above could be employed."

22. This sentence suggests that combined use of hydrophobic surfactants and polymers can be beneficial for dewatering, but that it does not state or imply that they can be used sequentially to improve dewatering.

23. In fact, hydrophobic polymers of high molecular weights are insoluble in water. To make them water dispersable, surfactants may be used as emulsifiers. Emulsifiers must be added simultaneously and not sequentially.

24. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 7th day of January, 2004.


Roe-Hoan Yoon

Garpenburg - Zn Filter Trial
Filter Cake Moisture Reduction
Target Moisture < 8.0 %

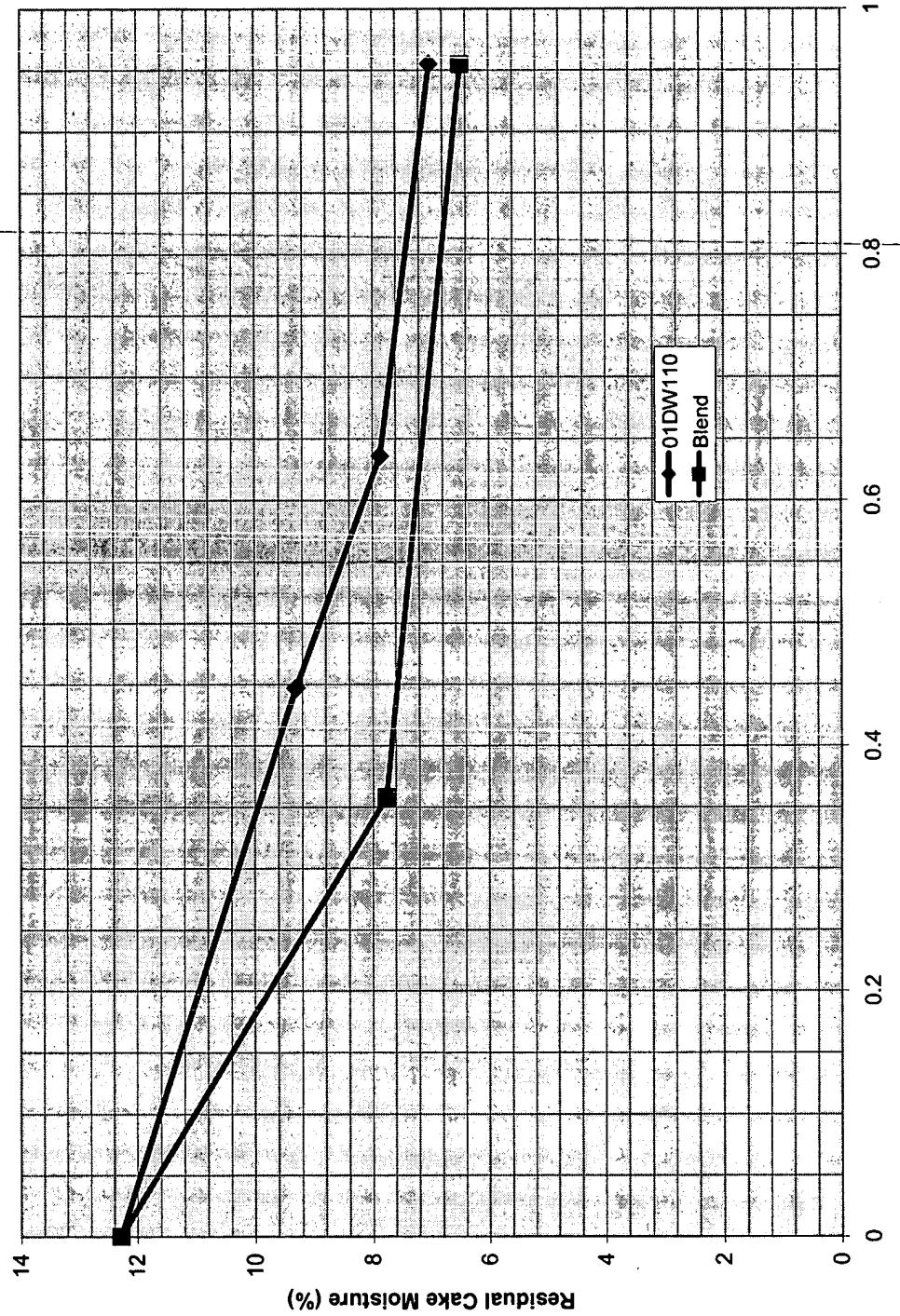


EXHIBIT A
DECLARATION OF DR. ROE-HOAN YOON UNDER 37 CFR §1.132

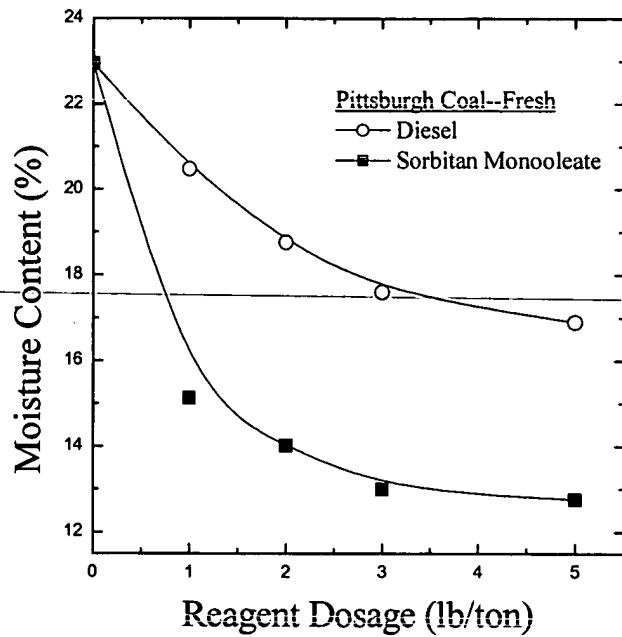


EXHIBIT B
DECLARATION OF DR. ROE-HOAN YOON UNDER 37 CFR §1.132

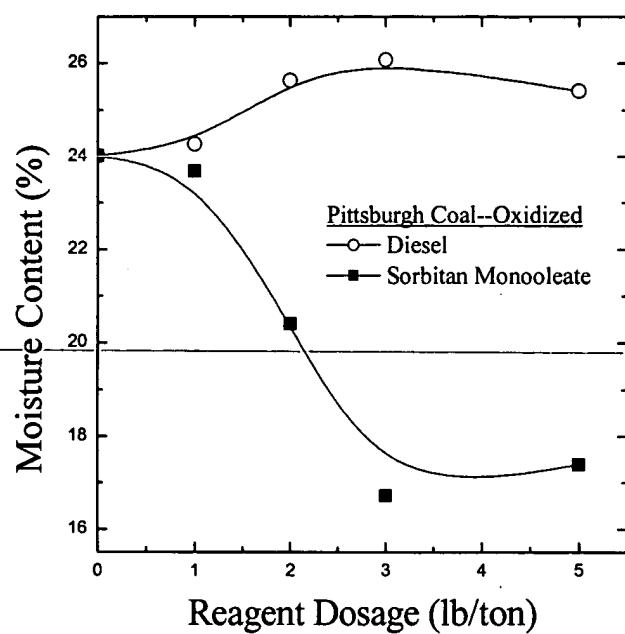


EXHIBIT C
DECLARATION OF DR. ROE-HOAN YOON UNDER 37 CFR §1.132